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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/753,393	01/09/2004	Takashi Udagawa	Q79052	7899

23373 7590 03/23/2005

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EXAMINER	
MONDT, JOHANNES P	

ART UNIT	PAPER NUMBER
2826	

DATE MAILED: 03/23/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/753,393	Applicant(s) UDAGAWA, TAKASHI	
	Examiner Johannes P. Mondt	Art Unit 2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 05 January 2005.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 22-32 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) 22,28 and 30 is/are allowed.

6)☒ Claim(s) 23-27,29,31 and 32 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 12/23/04.

4)☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. 3/10/05 .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____.

DETAILED ACTION

Response to Amendment

Amendment filed 1/5/2005 forms the basis of this office action. In said Amendment Applicant substantially amended claims 22, 23, 24, 25, 26 and 27 and added new claims 28-32.

Comments on Remarks are included below under "Response to Arguments".

Response to Arguments

1. Applicant's arguments filed 1/5/2005 have been fully considered but they are not fully persuasive. In particular, although the rejections under 35 U.S.C. 112 have been successfully overcome by the substantially amended claim set and accordingly claims 22, 28 and 30 are indicated as allowed (see Allowable Subject Matter), claims 23-27, 29 and 31 are rejected over the same prior art as cited. In agreement with the understanding reached between Applicant's Representative and Examiner on the intention to arrange for an interview after initial examination of the Specific Amendment Examiner on 3/10/05 initiated a phone call to Applicant's Representative to have an elaborate discussion on this application and with a specific proposal for an Examiner's Amendment that would place the application in condition for allowance. On March 15 Applicant's Representative informed the examiner that an action on the merits was preferred instead of a consideration of an examiner's proposal for an examiner's amendment at this time. Said proposal still stands in spite of the presently issued Final Rejection and consists of cancellation of claim 23, 29 and 31, of an amendment of

claims 24-27 and 32 that consists of removing their dependence on cancelled claim 23 (while retaining their dependence on claim 22), after which claims 22, 24-28, 30 and 32 would be allowed.

2. In traverse of the art rejections Applicant on pages 8-9 of Remarks based on the position of Applicant that "neither Terashima et al nor Ishida et al disclose or teach the phosphorus compositional ratio to obtain lattice matching with the BP-based buffer layer" examiner responds that (a) lattice matching was not in the original limitation of claims 22 and 23 but only now has been introduced (see underscored portion) in claims 22 and 23, while (b) the rejection of claims 22 and 23 in amended form is based on the lattice matching using As as taught by Terashima et al and the obviousness to replaced the lattice matching using As with replacing As by P in said lattice matching because lattice matching is just as straightforwardly achieved, considering the dependence of lattice constant on the stoichiometric parameter x. See new rejections under 35 U.S.C. 103(a). In both cases Vegard's Law holds to the same approximation and portends lattice matching for suitable selection of x. Therefore, the rejections under 35 U.S.C. 103(a) of the claimed subject matter that includes a double heterostructure have been adapted to the new claim language.

Information Disclosure Statement

The examiner has considered the items listed in the Information Disclosure Statement filed 12/23/2004. A signed copy of Modified PTO/SB/08 A & B (0603), which is a Substitute for Form PTO-1449 is enclosed with this office action.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. ***Claims 23-27, 29 and 31*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Terashima et al (6,069,021) (see Information Disclosure Statement filed 01/09/2004) in view of Ishida et al (6,339,014 B1). *Terashima et al teach* a group-III nitride semiconductor light-emitting device (cf. title, abstract and col. 1) comprising (cf. Example 3, Figure 2) a single crystal substrate 101 (cf. col. 5, l. 6-22 and col. 13, l. 59-65), a boron phosphide (BP)-based buffer layer 110 (cf. col. 14, l. 51-60) and a double hetero-junction light-emitting part structure containing a $GaN_{1-x}As_x$ lower clad layer 104 (0<x<1) (loc.cit.); N.B.: layer 104 is a GaN layer doped with As, which is a $GaN_{1-x}As_x$ layer*), the As compositional ratio (x) of the $GaN_{1-x}As_x$ lower clad layer is set to obtain the lattice matching with the BP-based buffer layer* (col. 7, l. 60 – col. 8, l. 3),a GaγIn1-γN (0<= γ <= 1) light-emitting layer 105 (cf. col. 14, l. 65-col. 15, l. 3) and an $Al_zGa_{1-z}N$ (0<= z <= 1) upper clad layer 106 (cf. col. 15, l. 4-12; N.B. the parameter range for z as claimed includes the point z=0) having a conduction type (p-type) (cf. loc.cit.) opposite to that of the lower clad layer (which has n-type conductivity, see col. 14, l. 52).

Terashima et al do not necessarily teach the lower clad layer to be a $GaN_{1-x}P_x$ lower clad layer instead of a $GaN_{1-x}As_x$ lower clad layer, because Terashima et al teach

doping the GaN layer 104 with As. *However, it would have been obvious* to use P instead of As for doping in view of Ishida et al, who, in a patent on a method for growing nitride compound semiconductors (cf. title and abstract), hence closely related to Terashima et al, teach at least the equivalence of using P rather than As for the growing of n-type GaN layers (cf. col. 6, l. 62 – col. 7, l. 15); given the use of P-doping in a prior step in Terashima et al, namely in the formation of the buffer layer (cf. col. 13, l. 59-65 in Terashima et al) it would have been obvious to use the same dopant thus obviating the need for additional complexity in the manufacturing process, while the lattice matching achieved by selecting As as taught by Terashima et al and selecting x could have been equally straightforwardly achieved through doping with P (phosphorous): in particular, the exploitation of the doping for the specific purpose of lattice matching can be equally achieved through the selection of P instead of As at the same stoichiometric ratio of x=0.01, considering that the lattice constant of $GaN_{1-x}P_x$ for x=0.01 (4.519 A) is just as much substantially the same as the lattice constant of 4.520 A of the surface portion of the buffer layer 110 above it (cf. Figure 2) as the lattice constant of $GaN_{1-x}As_x$ for the same value of x (i.e., 4.521 A) (cf. col. 14, l. 52-60). It is noted that "lattice matching" and "excellent" "lattice matching" in the context of the Specification mean lattice-matching within 1% and 0.4%, respectively (see Specification, page 16), which is amply met be Terashima et al: the lattice matching achieved by Terashima et al is 0.002/4 = 0.0005 or 0.05%. Thus, the statement of "zero" lattice matching" in the Specification on page 21 must be read within the context of the standard deviations indicated in the Specification as discussed above.

Motivation to replace As with P in this regard derives at least from the economic saving of using the P source already in use for the process of making the buffer layer in the device by Terashima (cf. col. 13, l. l. 53-65) instead of having to use the As source (cf. col. 14, l. 43-50), and in addition from the obvious toxic nature of As.

On claim 24: the further limitation on the invention as now claimed by substantially amended claim 23, claiming a range for the dislocation density of a lattice-matched lower clad layer, is not disclosed in the Specification other than being achieved through the reduction of lattice mismatch to levels defined in the Specification to amount to lattice matching (i.e., less than 1% and preferentially less than 0.4%; see page 16 of the Specification and final paragraph of the "Summary of the Invention" and page 29, first full paragraph). Because said reduction of lattice mismatch is equally if not better achieved by the prior art as discussed above (claim 23) Applicant in the Specification does not disclose a different range for said dislocation density than as found in the prior art.

On claim 25: the light emitting layer105 by Terashima has the same lattice constant of 4.51 A as does the upper surface of the second buffer layer 104 (for x=0.12 and Vegard's Law applied to GaInN for x=0.12). Because said second buffer layer lattice matches to said lower clad layer it follows that the light emitting layer lattice matches to said lower clad layer, and hence the combined invention by Terashima et al in view of Ishida et al meets the further limitation as defined by claim 25. In this regard please note that Ishida et al only needs to teach a different material constitution of the

lower clad layer but without any modification to its lattice constant (see discussion of claim 23 above).

On claim 26: because the same lattice matching procedure is successfully applied in the prior art as is in the invention and because Applicant discloses the claimed range for the dislocation density only to be due to said lattice matching the further limitation as defined by claim 26 does not further distinguish over the prior art either. Please note that in both the invention and in Terashima the production method of the light-emitting layer is MOCVD (Terashima et al, col. 9, l. 38-46 and page 28 of the Specification).

On claim 27: the buffer layer has a lattice constant (4.52 A) of the original crystal of the material on the buffer layer surface opposite the junction interface with the substrate (i.e., opposite the surface that forms part of said junction interface), because the upper surface of the buffer layer is part of the buffer layer. Furthermore, the thickness of the buffer layer is 200 A (col. 14, 39), i.e., 20 nm which is in the range of 5 nm to 50 nm as claimed. Parenthetically, the limitation "original" does not carry any patentable weight, the final structure being the subject of the present invention. To amplify, in reference to the claim language referring to "original", intended use and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result

in a manipulative difference as compared to the prior art. In re Casey,152 USPQ 235 (CCPA 1967); In re Otto , 136 USPQ 458, 459 (CCPA 1963).

On claims 29 and 31: Terashima et al teach a group-III nitride semiconductor light-emitting device (cf. title, abstract and col. 1) comprising (cf. Example 3) a single crystal substrate 101 (cf. col. 5, l. 6-22 and col. 13, l. 59-65), a boron phosphide (BP)-based buffer layer 110 (cf. col. 14, l. 51-60) and a double hetero-junction light-emitting part structure containing a $GaN_{1-x}As_x$ lower clad layer 104 (0<x<1) (cf. col. 14, l. 52-60; N.B.: layer 104 is a GaN layer doped with As, which is a $GaN_{1-x}As_x$ layer*), the As compositional ratio (x) of the $GaN_{1-x}As_x$ lower clad layer is set to obtain the lattice matching with the BP-based buffer layer* (col. 7, l. 60 – col. 8, l. 3),a GaγIn1-γN (0<= γ <= 1) light-emitting layer 105 (cf. col. 14, l. 65-col. 15, l. 3) and an $Al_zGa_{1-z}N$ (0<= z <= 1) upper clad layer 106 (cf. col. 15, l. 4-12; N.B. the parameter range for z as claimed includes the point z=0) having a conduction type (p-type) (cf. loc.cit.) opposite to that of the lower clad layer (which has n-type conductivity, see col. 14, l. 52). The lattice mismatch between the BP-based buffer layer and the GaN1-xAsx lower clad layer by Terashima et al is 0.05% as discussed above in the rejection of claim 23, and again below in connection with the obviousness to include the teaching by Ishida et al, meets the limitation on lattice mismatch bounds of both claims 29 and 31.

Terashima et al do not necessarily teach the lower clad layer to be a $GaN_{1-x}P_x$ lower clad layer instead of a $GaN_{1-x}As_x$ lower clad layer, because Terashima et al teach doping the GaN layer 104 with As while yet meeting the requirement of lattice matching to within a lattice mismatch of 1 %. *However, it would have been obvious* to use P

instead of As for doping in view of Ishida et al, who, in a patent on a method for growing nitride compound semiconductors (cf. title and abstract), hence closely related to Terashima et al, teach at least the equivalence of using P rather than As for the growing of n-type GaN layers (cf. col. 6, l. 62 – col. 7, l. 15); given the use of P-doping in a prior step in Terashima et al, namely in the formation of the buffer layer (cf. col. 13, l. 59-65 in Terashima et al) it would have been obvious to use the same dopant thus obviating the need for additional complexity in the manufacturing process, while the lattice matching achieved by selecting As as taught by Terashima et al could have been equally straightforwardly achieved through doping with P (phosphorous): in particular, the exploitation of the doping for the specific purpose of lattice matching can be equally achieved through the selection of P instead of As at the same stoichiometric ratio of x=0.01, considering that the lattice constant of $GaN_{1-x}P_x$ for x=0.01 (4.519 A) is just as much substantially the same as the lattice constant of 4.520 A of the surface portion of the buffer layer 110 above it (cf. Figure 2) as the lattice constant of $GaN_{1-x}As_x$ for the same value of x (i.e., 4.521 A) (cf. col. 14, l. 52-60). It is noted that "lattice matching" and "excellent" "lattice matching" in the context of the Specification mean lattice-matching within 1% and 0.4%, respectively (see Specification, page 16), which is amply met be Terashima et al: the lattice matching achieved by Terashima et al is 0.002/4 = 0.0005 or 0.05%. Thus, the statement of "zero" lattice matching" in the Specification on page 21 must be read within the context of the standard deviations indicated in the Specification as discussed above.

Motivation to replace As with P in this regard derives at least from the economic saving of using the P source already in use for the process of making the buffer layer in the device by Terashima (cf. col. 13, l. l. 53-65) instead of having to use the As source (cf. col. 14, l. 43-50), and in addition from the obvious toxic nature of arsenic (As).

2. ***Claim 32*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Terashima et al and Ishida et al as applied to claim 23 above, and further in view of Prior Art as Admitted by Applicant. Although Terashima et al do teach a Group III semiconductor nitride crystal "formed of excellent quality" (col. 8, l. 13-20) Terashima et al do not characterize said crystal to be a single crystal. As a preliminary matter, single crystal as used in the Specification still allows crystal imperfections, such as dislocations. *It would have been obvious to include the further limitation as defined by claim 32 in view of Prior Art as Admitted by Applicant*, teaching although MOCVD is known in the prior art to produce a GaN based light-emitting layer as a single crystal (page 1) accept in the absence of lattice matching to an underlying substrate (page 2). Since lattice matching is taught by Terashima et al as explained above, it would have been obvious to characterize said Group III semiconductor nitride crystal of excellent quality as a single crystal.

Allowable Subject Matter

3. ***Claims 22, 28 and 30*** are allowed. The following is a statement of reasons for the indication of allowable subject matter: within the context of claim 22 or claim 28, i.e.,

group-III nitride semiconductor light-emitting device on a single crystal substrate with a buffer layer based on boron phosphide, *the single heterostructure as claimed, i.e., the single heterostructure consisting of a GaInN light emitting layer and a GaNP lower clad layer has not been found* in the prior art.

Conclusion

4. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J. Flynn can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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JPM
March 10, 2005